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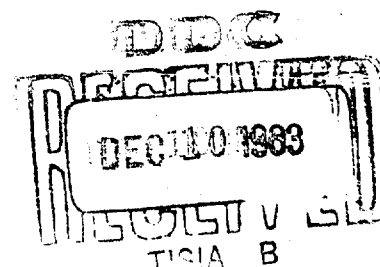
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# TECHNICAL MANUSCRIPT 78

## USE OF THE ZENITH GEAR PUMP IN CONTINUOUS CULTURE SYSTEM

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USE OF THE ZENITH GEAR PUMP IN CONTINUOUS CULTURE SYSTEM

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## USE OF THE ZENITH GEAR PUMP IN CONTINUOUS CULTURE SYSTEM

ABSTRACT

The use of the Zenith Gear Pump to feed small volumes of media in continuous microbiological culture work is described. This positive-displacement pump can be operated over a wide range of flow rates without the pulsating flow that occurs with peristaltic pumps, and with greater accuracy than either peristaltic or gravity-flow feeding systems. With minor modifications and special sterilizing procedures, continuous runs up to forty-four days have been achieved.

Various types of feeding systems have been employed for the delivery of small volumes of media in continuous culture work. Gravity flow systems utilizing capillary tube restrictions have been used, but the degree of accuracy is variable.\* Peristaltic pumps, available in many forms, have proved satisfactory in many cases; however, at very low flow rates, accuracy is lost. Small peristaltic pumps, such as the hospital type, give accurate delivery of medium, but the problems of tubing erosion and pulsating flow, common to all peristaltic types and to many other types of pumps, still exist. Pulsating flow is objectionable wherever a steady flow of material is desired and whenever measurement of flow is by use of such devices as rotameters. For this reason, the Zenith\*\* Gear Pump was selected and evaluated for the following characteristics: (a) accuracy, (b) ease of sterilizing, and (c) maintenance of sterility under prolonged operating conditions.

The Zenith pump is a gear-type, positive-displacement pump (Figures 1 and 2) designed primarily for use in the synthetic fiber industry. The pump has been also used in automating titration of liquids in some laboratories. One revolution delivers 0.274 milliliter. By controlling the speed of the pump, one may obtain a wide range of flow rates. The pump is small, can be disconnected from the gear-drive and sterilized by autoclaving, and then replaced. Aseptic connections to the medium reservoir and culture vessel are made by inserting hypodermic needles, secured to rubber tubing, through skirt-type rubber stoppers fixed to outlets on the vessels.

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\* Cohen, Edward P., and Eagle, Harry "A simplified chemostat for the growth of mammalian cells: Characteristics of cell growth in continuous culture," J. Exptl. Med. 113:467-474, 1961.

\*\* Zenith Products Co., West Newton 65, Massachusetts.

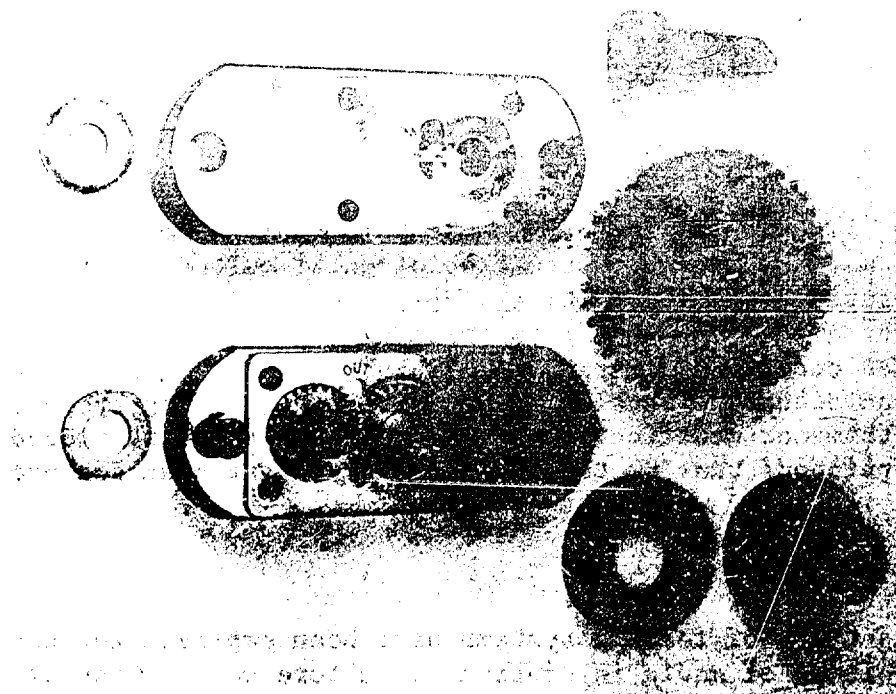


Figure 1. Zenith Gear Pump, Disassembled.  
(FD Neg C-6783)



Figure 2. Zenith Gear Pump, Assembled.  
(FD Neg C-6784)



With regard to accuracy and constancy of nonpulsating flow, the Zenith pump seems without peer. In achieving sterility, however, two changes were made on the original pump; the metal washers were replaced with Teflon washers; the original housing, found to have rusted after repeated autoclaving, was replaced with a better grade of stainless steel. Though initial experiments indicated that sterility could be achieved and maintained, later results showed that this could be maintained for longer periods when the body of the pump was wrapped with cotton and then gauze prior to sterilization. The routine of dismantling, cleaning, reassembling, and rewrapping with cotton prior to sterilizing proved suitable in practice. The longest run achieved was a total of 44 days. Rates have varied from 0.4 to 1.6 milliliters per minute. Flow meters or rotameters of suitable size have been incorporated into the system and found to function with no pulsation such as that found with the peristaltic type of pump.

Though the pump operates satisfactorily with the above modification and protocol, the shaft seal should be modified to increase assurance of prolonged sterility.